# SMUD'S ZEH PROGRAM

Presentation to California Energy Commission
June 8, 2004

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# Agenda

- SMUD's Experience
- Benefits of Solar
- Lessons Learned
- Recommendations for New Home Market

# Why PV In Residential New Construction?

- High growth potential
  - High volume drives down costs
  - Standardized system design
  - Builders are masters of cost cutting
  - Lowest installation cost
- Marketability of zero-energy homes
  - Energy efficiency with 2 kW PV Energy Roofs
  - Potential: 19+MW DG capacity in District per year
  - 260+ MW DG capacity statewide per year

# SMUD'S New Home PV Experience

- Built on experience and success of efficiency program
  - Voluntary approach with options for builder
  - Pegged to T-24 Standards
  - Early adopters gained competitive market advantage
  - Market driven over time as builders recognized value to home buyers

# SMUD'S New Home PV Experience

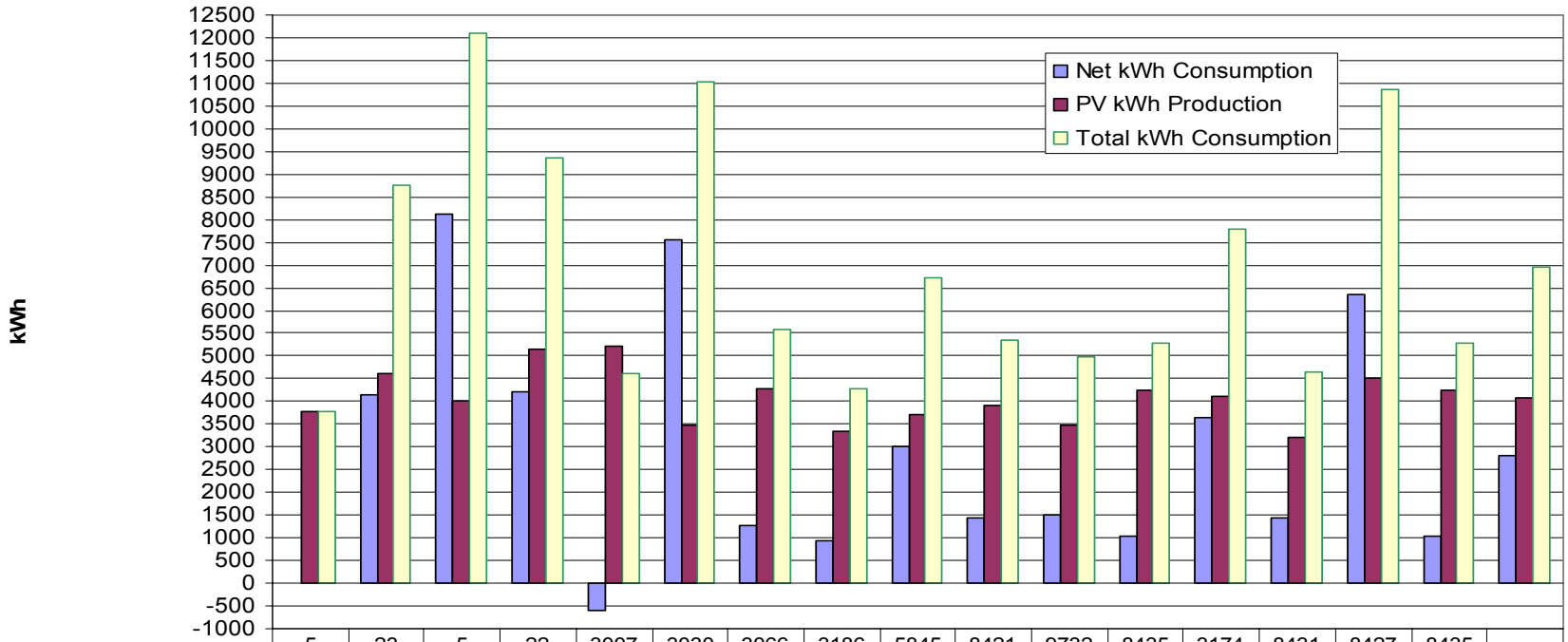
- Initiated December 2000
- Eight production home Builders
- 124 new homes & townhouses in 19 subdivisions
- First production home ZEH – Beazer Powerhouse
- 100+ ZEH homes under construction

# Residential New Construction

# Beazer Powerhouse Results

- Offered as optional upgrade in 4 communities
- 18 Homes built (approx. 60 kW)
  - 16 occupied by owner for 1+ year
- **13 of 16 owner occupied homes produced more energy than they purchased from SMUD**

# Beazer Powerhouse kWh Consumption




| | 5 Cencibel | 23 Alcano n | 5 Alcano n | 22 Tempr anillo | 3007 Guada lajara | 3030 Guada lajara | 3066 Guada lajara | 3186 Guada lajara | 5845 Ridgep oint | 8421 Sundr op | 9732 Paso Fino | 8435 White Spruc | 3174 Guada lajara | 8431 White Spruc | 8427 White Spruc | 8435 White Spruc | Averag e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net kWh Consumption | 5 | 4157 | 8114 | 4222 | -600 | 7545 | 1287 | 932 | 3010 | 1424 | 1492 | 1039 | 3649 | 1443 | 6355 | 1039 | 2820 |
| PV kWh Production | 3770 | 4601 | 3999 | 5136 | 5208 | 3477 | 4290 | 3346 | 3704 | 3911 | 3481 | 4233 | 4129 | 3195 | 4516 | 4233 | 4077 |
| Total kWh Consumption | 3775 | 8758 | 12113 | 9358 | 4608 | 11022 | 5577 | 4278 | 6714 | 5335 | 4973 | 5272 | 7778 | 4638 | 10871 | 5272 | 6956 |

# Morrison Lakeside Community ZEH Project

ZERO Energy Homes

SMUD Sacramento Municipal Utility District

energy Money Isn't All You're Saving

ComfortWise

ASTROPOWER

Morrison Homes

# SMUD's Participation
# Lakeside

- Energy efficiency incentives - $14,000
- Buydown of the PV system - $150,000
  - Installed costs ≈ $8.75/w AC
  - Builder pays $4/watt ($2.60/w equipment + install $1.40/w)
  - $4.75/w AC PV buydown (approx. 20 homes w/ 2 kW PV system)
- Marketing Support - $20,000

# Lakeside ZEH Features

## 36% - 41% > 01 Title-24 Standards

| Measure | Base | ZEH |
|---|---|---|
| Low Air Infiltration | No | **Yes** |
| Windows | Vinyl, Low-e | **Vinyl, Low SHGC** |
| HVAC | | |
| FURN AFUE | 0.78 | **0.92** |
| A/C SEER | 10 | **14 w/TXV** |
| ACCA Design | No | **Yes -- Short Runs** |
| Water Heating | | |
| Tank | 50 gal storage | **Tankless** |
| Energy Factor | 0.60 | **0.82** |
| Distribution | Standard | **Pipe insulation** |
| **Comfortwise Inspections & Tests** | | |
| **Fluorescent Lighting** | | **2kW AC PV** |

# ZEH PV System

- 48 GE Energy GT 55 BIPV Modules
  - 2 kW AC
- One Source Circuit
- High-Voltage
- SMA 2500 Inverter
- PV System Sizing
  - T-24/Engineering Analysis

# Premier Gardens Community ZEH Project

SMUD Sacramento Municipal Utility District

Energy Money Isn't All You're Saving

ComfortWise

GE Energy

231 Lake Drive, Newark, DE 19702

Premier Homes

# SMUD's Participation
# Premier Gardens

- Total: $965,747
  - Buydown of the AstroPower modules -- $663,670
    - Installed Costs ≈ $7.86 /watt AC Installed
    - Builder pays $4.36 (PV equipment + install)
    - $3.50/watt AC (avg) PV Buydown
  - Energy efficiency incentives - $66,500
  - Marketing Support - $20,000
  - In-kind Staff Support -- $215,577

# Premier Gardens ZEH Features

## 32% - 34% > 01 Title-24 Standards

| Measure | Base | ZEH |
|---|---|---|
| Attic Insulation | R-30 | **R-38** |
| Low Air Infiltration | No | **Yes** |
| Windows | Vinyl, Low-e | **Vinyl, Low SHGC** |
| FURN AFUE | 0.78 | **0.92** |
| A/C SEER | 10 | **14 w/TXV** |
| ACCA Design | No | **Yes -- Short Runs** |
| Water Heater | storage EF .60 | **Tankless EF .87** |
| Distribution | Standard | **Pipe insulation** |

**Comfortwise Inspections & Tests**

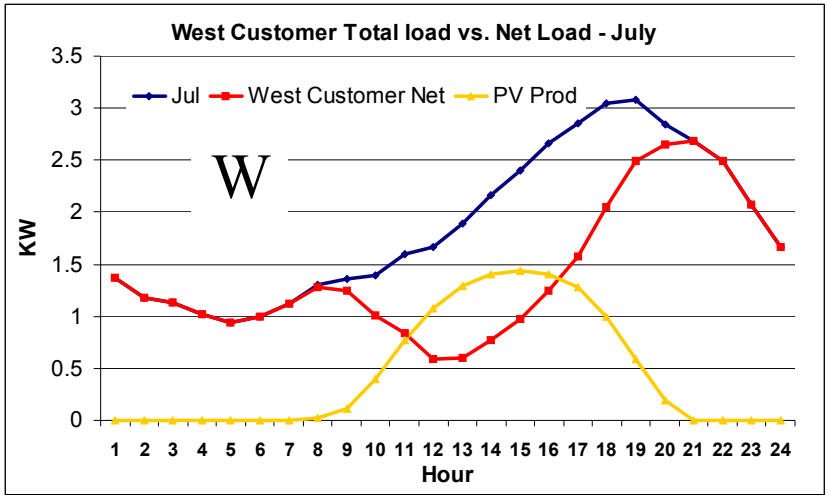
**Fluorescent Lighting**

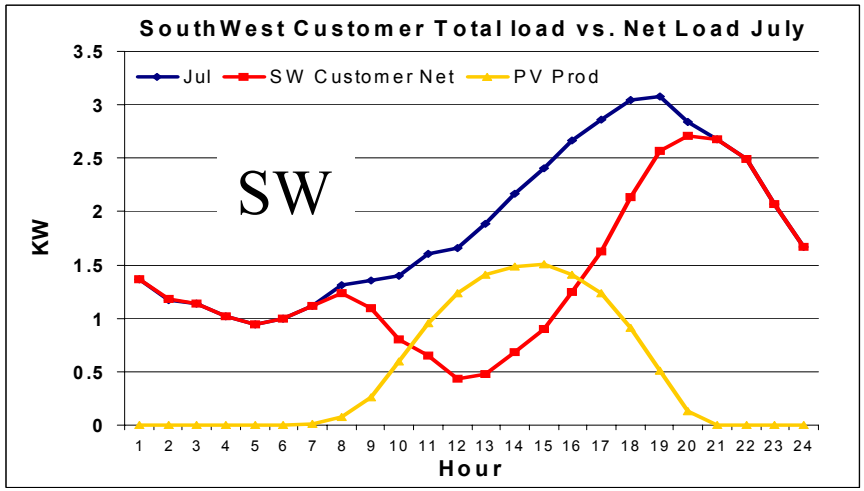
**2kW AC PV**

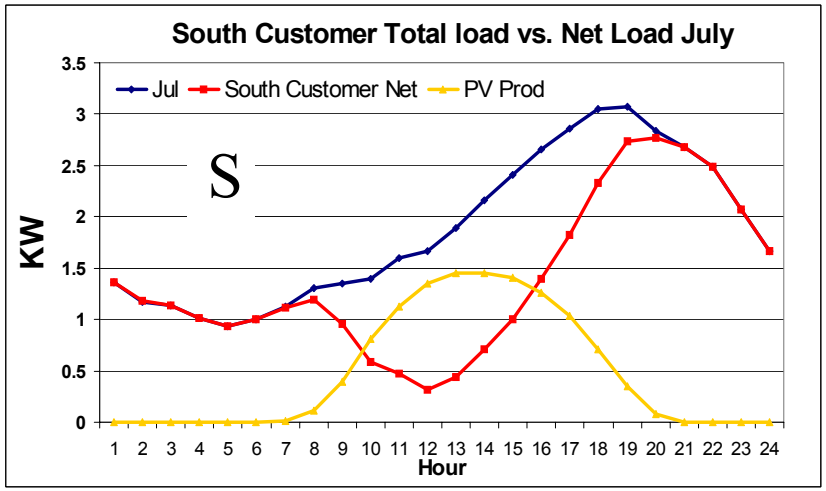
# Next Steps

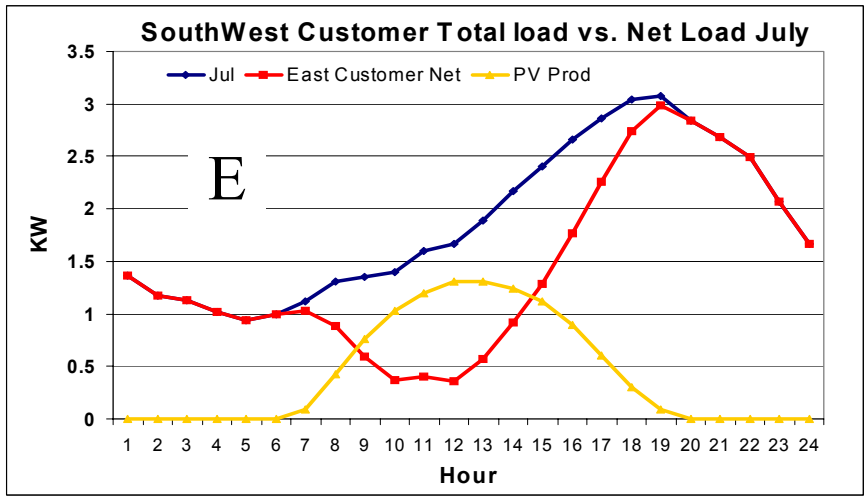
- Side-by-Side Evaluation of ZEH vs Non-ZEH Communities
  - Power production
    - Monitor energy savings/production
    - Monitor peak demand savings
  - Evaluate distribution system impacts
    - Voltage Flicker and Harmonic Distortion
- Adopt ZEH into SMUD's residential new construction program

# Hourly Curves - July

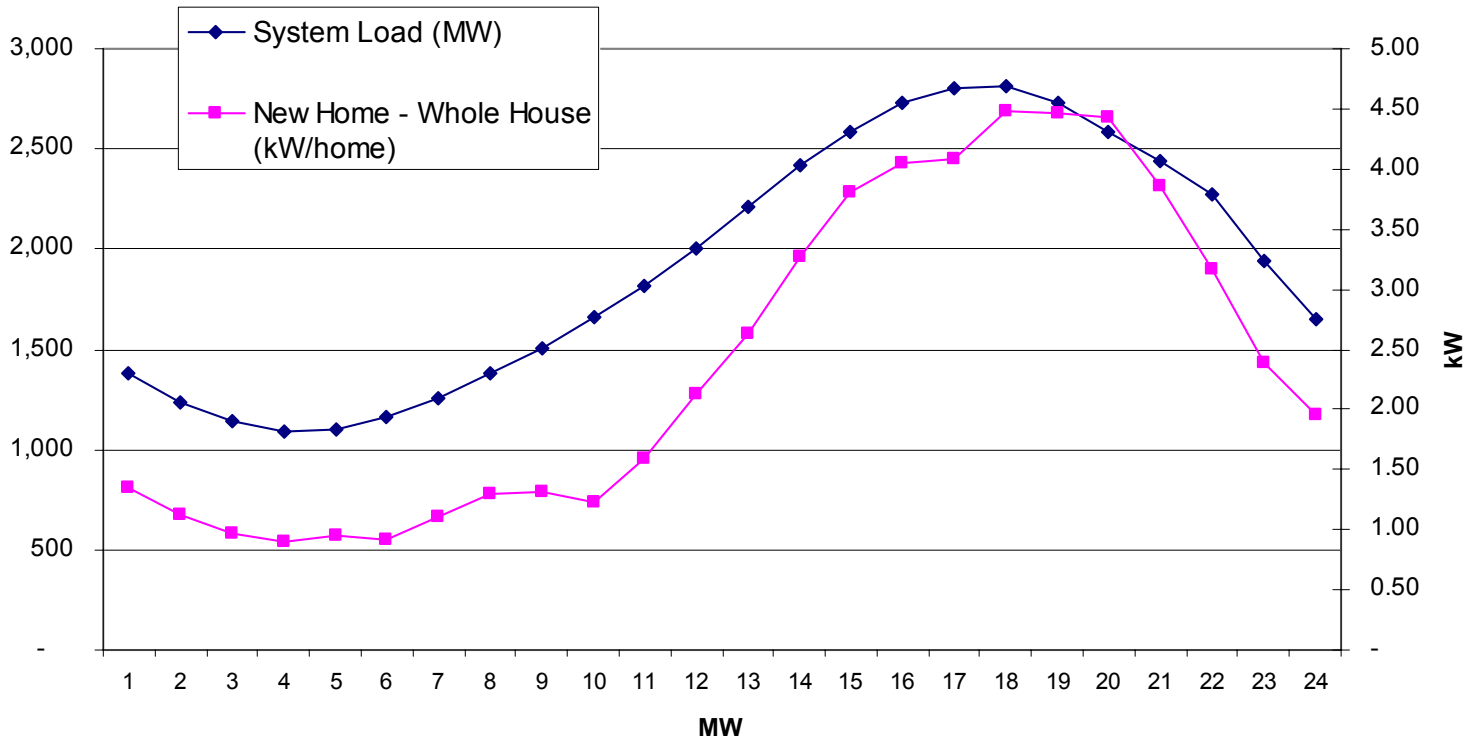


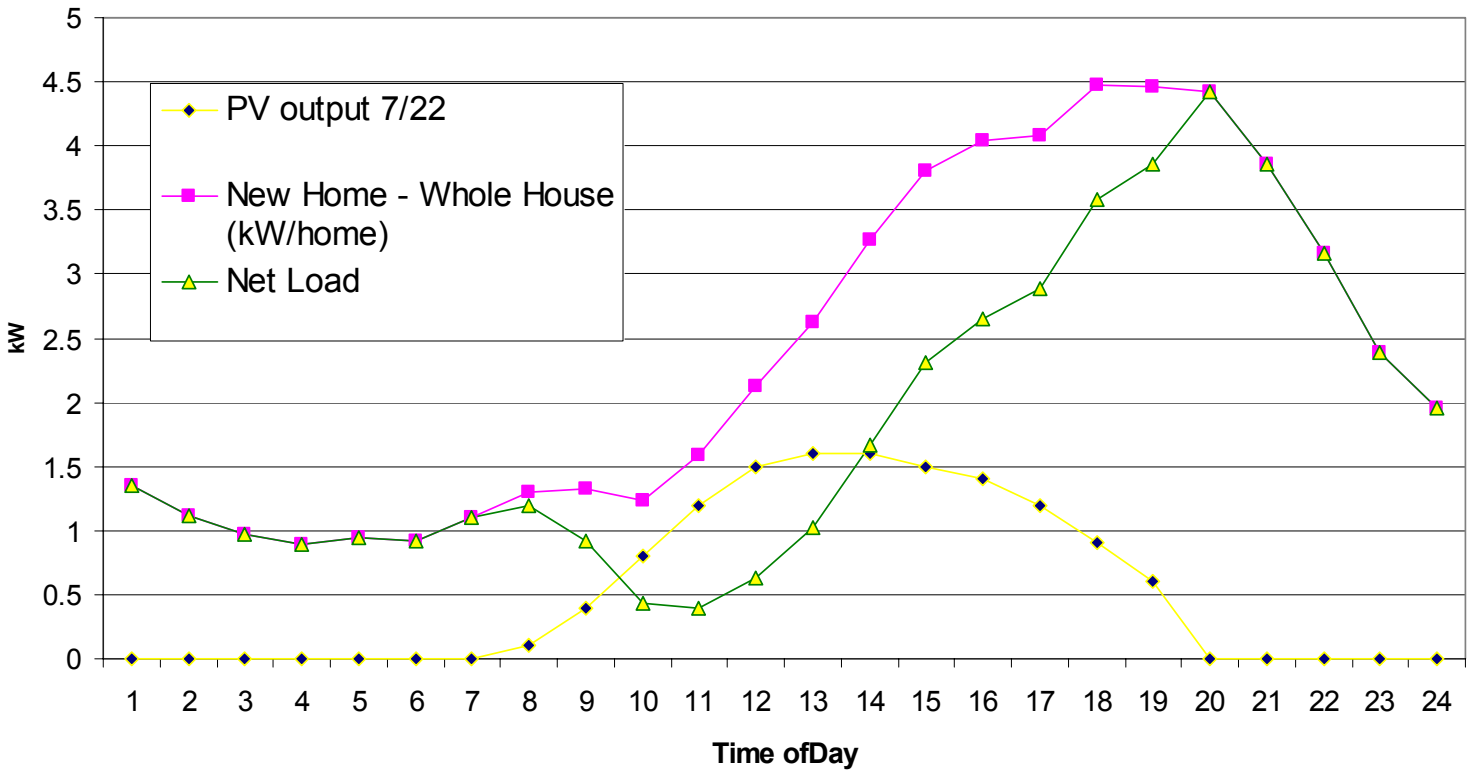



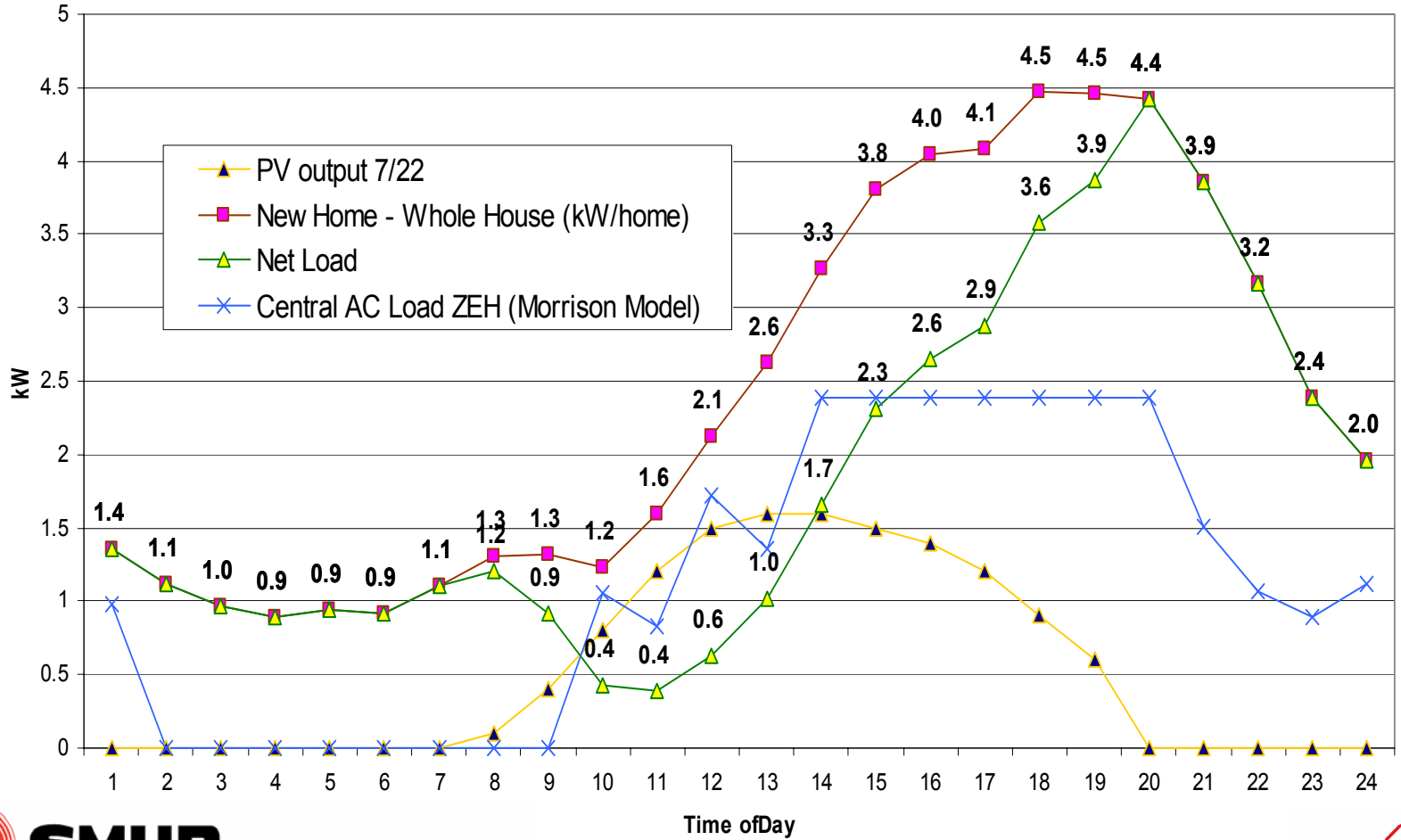
# System Load July, 2003 vs New Home Load



# New Home Load with PV Production



# Estimated ZEH Load Impact



# Peak Shaving Opportunities

- West or Southwest facing systems provide the best combination of peak reduction, super-peak energy, and annual energy production
- Targeting deployment to grid constrained areas will be more advantageous in the near to mid-term considering size in relation to State's grid
- Working with builders to orient roof integrated arrays to W or SW would provide maximum benefit
- Stable pricing provided by distributed PV can protect against grid price spikes like those seen in 2001, but only with large enough penetration.

# Lessons Learned

- Clear builder/buyer preference for roof-integrated PV systems over roof mounted PV systems.
- Builders want to use their own subcontractors.
- PV manufacturers must be full service suppliers – installation support, sales training, warranty.
- New home buyers are unfamiliar with the benefits of owning their own PV system.
- Pricing to builder is key – it must be perceived and offered as affordable to home buyer.
- Least expensive PV program option ($4.37/Watt)
- Prices fell quickly $10.45/watt to $7.86/watt AC with small volumes.

# Summary

- PV system costs will fall as market builds
- Buyers like PV/ZEH
- ZEH production homes offer substantial electric utility bill savings

BUT

- Builders need PV with proper products, incentives and support
- Builders want branded, turnkey systems backed by long-term warranties and service

# Recommendations

- Expand ZEH program
- Encourage major PV manufacturers to develop roof-Integrated PV products for the USA market.
- Make PV beneficial to utilities. Expand research on utility benefits of ZEH.
- Sponsor research and development of PV Roofs (Japanese PV model)
- Support California New Home Solar Initiative

# For More Information:

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